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Parameter Fitting of the Discrete Element Method When Modeling the DISAMATIC Process

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Abstract : In sand casting of metal parts for the automotive industry such as brake disks and engine blocks, the molten metal is poured into a sand mold to get its final shape. The DISAMATIC molding process is a way to construct these sand molds for casting of steel parts and in the present work numerical simulations of this process are presented. During the process green sand is blown into a chamber and subsequently squeezed to finally obtain the sand mould. The sand flow is modelled with the Discrete Element method (DEM) and obtaining the correct material parameters for the simulation is the main goal. Different tests will be used to find or calibrate the DEM parameters needed; Poisson ratio, Young modulus, rolling friction coefficient, sliding friction coefficient and coefficient of restitution (COR). The Young modulus and Poisson ratio are found from compression tests of the bulk material and subsequently used in the DEM model according to the Hertz-Mindlin model. The main focus will be on calibrating the rolling resistance and sliding friction in the DEM model with respect to the behavior of "real" sand piles. More specifically, the surface profile of the "real" sand pile will be compared to the sand pile predicted with the DEM for different values of the rolling and sliding friction coefficients. When the DEM parameters are found for the particle-particle (sand-sand) interaction, the particle-wall interaction parameter values are also found. Here the sliding coefficient will be found from experiments and the rolling resistance is investigated by comparing with observations of how the green sand interacts with the chamber wall during experiments and the DEM simulations will be calibrated accordingly. The coefficient of restitution will be tested with different values in the DEM simulations and compared to video footages of the DISAMATIC process. Energy dissipation will be investigated in these simulations for different particle sizes and coefficient of restitution, where scaling laws will be considered to relate the energy dissipation for these parameters. Finally, the found parameter values are used in the overall discrete element model and compared to the video footage of the DISAMATIC process.

Keywords : discrete element method, physical properties of materials, calibration, granular flow
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